DOI: 10.4025/jphyseduc.v31i1.3161

Review Article

EFFECT OF DIFFERENT INTERVAL TRAINING PROTOCOLS ON ADIPOSITY INDICATORS IN OVERWEIGHT-OBESE CHILDREN AND ADOLESCENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

EFEITO DE DIFERENTES PROTOCOLOS DE TREINAMENTO INTERVALADO SOBRE INDICADORES DE ADIPOSIDADE EM CRIANÇAS E ADOLESCENTES COM SOBREPESO E OBESIDADE: UMA REVISÃO SISTEMÁTICA E METANÁLISE

Francisco José de Menezes-Junior[1], **Íncare Correa de Jesus**[1], **Vinícius Lins Ferreira**[1], **Astrid Wiens**[1], **Jorge Mota**[2] and **Neiva Leite**[1]

[1]Paraná Federal University, Curitiba-PR, Brazil.
[2]University of Porto, Porto, Portugal.

RESUMO

A presente meta-análise verificou o impacto de diferentes protocolos de treinamento intervalado de alta intensidade (HIIT) sobre indicadores de adiposidade em crianças e adolescentes com sobrepeso e obesidade. As buscas foram realizadas nas bases de dados: PubMed, ScienceDirect, SPORTDiscus, LILACS e SciELO. Foram incluídos estudos sem restrição calórica, que objetivaram verificar o efeito das intervenções do HIIT nos indicadores de adiposidade em crianças e adolescentes acima do peso publicados até dezembro de 2018. A escala PEDro foi utilizada para avaliar o risco de viés. A meta-análise foi conduzida no software Revman a partir dos dados de diferença média padronizada (SMD) e intervalos de confiança de 95% (IC). Foram selecionados 17 estudos, envolvendo 289 crianças e adolescentes com sobrepeso e obesidade. As intervenções de HIIT (duração=11,7±5,9 semanas) produziram reduções significativas no percentual de gordura corporal (SMD=-0,65; IC=-1,07,-0,23) e circunferência da cintura (SMD=-0,34; IC=-0,49-0.18). Também foi observado um risco relativo maior de diminuição do percentual de gordura corporal a favor de protocolos com proporção de intervalos de trabalho/recuperação de 1:1 e 2:1. Protocolos HIIT com proporções 1:1 e 2:1 promovem reduções significativas no percentual de gordura e circunferência da cintura em crianças com sobrepeso e obesidade, independentemente do tempo total de trabalho.
Palavras-chave: Treinamento intervalado. Gordura corporal. Circunferência da cintura. Obesidade. Adolescentes.

ABSTRACT

The present meta-analysis verified the impact of different protocols of high-intensity interval training (HIIT) on indicators of adiposity in overweight and obese children and adolescents. Searches were performed in the databases: PubMed, ScienceDirect, SPORTDiscus, LILACS and SciELO. Were included studies without caloric restriction that aimed to verify the effect of HIIT interventions on the adiposity indicators in overweight children and adolescents published until December 2018. The PEDro scale was used to assess the risk of bias. The meta-analysis was conducted in the Revman software using standardized mean difference (SMD) data and 95% confidence intervals (CI). Seventeen studies were selected, which involved 289 children and adolescents with overweight and obesity. HIIT interventions (mean=11.7±5.9 weeks) produced significant decreases in body fat percentage (SMD=-0.65; CI=-1.07, -0.23) and waist circumference (SMD=-0.34; CI=-0.49, -0.18). Also, major relative risk of decrease in body fat percentage were observed in favour to protocols with work/recovery interval ratios of 1:1 and 2:1. HIIT protocols with ratios (work/recovery intervals) 1:1 and 2:1 promote significant reductions in fat percentage and waist circumference in overweight and obese children, independently of the total work time.
Keywords: Interval training. Body fat. Waist circumference. Obesity. Adolescents.

Introduction

Obesity is often associated with various metabolic disorders, such as an increase in blood pressure levels, dyslipidaemia, insulin resistance and type 2 diabetes[1]. Excessive accumulation of subcutaneous fat, presented in nutritional states and characterised as overweight, obesity or central obesity, may cause health risk[2]. In the last forty years the obesity is becoming more prevalent among children and adolescents worldwide, which can increase the chances of developing disease in adulthood and reduce the lifespan and quality of life[3].

Different exercise interventions, such as high-intensity interval training (HIIT) have been used to minimise the disorders caused by the accumulation of adiposity. This type of training has grown in popularity in recent years and presents itself as one of the most effective methods for improving cardiorespiratory and metabolic functions.[4] Several systematic reviews with meta-analysis showed a beneficial effect of HIIT on several health parameters in numerous populations[4–6]. In overweight and obese children and adolescents, HIIT presented relevant benefits related to cardiorespiratory capacity and blood pressure, compared to other forms of exercise[4]. Furthermore, this training method also shows to be effective in reducing the indicators of adiposity, such as body fat percentage, body mass and waist circumference in the paediatric population[7].

The prescription of HIIT consists of manipulating up to nine variables, such as intensity and duration of the work, intensity and duration of recovery, exercise modality, number of repetitions, number of series as well as duration and intensity of recovery between series[8]. Management of any of these variables may affect acute and chronic physiological responses[5,9,10]. HIIT is characterized by brief, repeated bursts of high-intense exercise (work interval) interspersed by periods of recovery or low-intensity exercise[11], and both will regulate the workload of an HIIT session. A rigorous "working interval" is the main drive to promote training adaptations[11], and an effective HIIT protocol can only be achieved when work intervals are separated by adequate recovery[12]. Furthermore, the ratio between work and recovery intervals, may impact the total training volume and the final response of the intervention[13].

However, despite the increasing evidence on the types of interval training in the literature, there is still no systematic analysis on whether the relationship between work and recovery promotes better benefits in adiposity indicators in overweight and obese children and adolescents. Due to this gap, the researchers investigated the various protocols without a systematised literary body. Therefore, to better elucidate the understanding on the topic and to point out a direction of which protocol could be further explored in future studies, we see the need for an in-depth systematic analysis on the effect of work and recovery interval ratios. Thus, the purpose of this systematic review and meta-analysis was to determine the impact of different interval training protocols on indicators of body adiposity in overweight and obese children.

Methods

Study design

The present study was carried out based on the recommendations of the *Preferred Reporting Items for Systematic Review and Meta-analyses*: *The PRISMA Statement*[14]. No other study of HIIT protocols has been published before the initiation of the meta-analysis. This systematic review was prospectively registered on the PROSPERO database (CRD42019139450).

Types of studies

Were included all original studies, RCTs and non-RCTs that involved children and/or adolescents with overweight or obesity, which aimed to verify the effect of HIIT interventions on the adiposity indicators.

Types of participants

Were included children and/or adolescents, of both sexes, aged between 6 and 18 years-old, non-athletes, with no disabilities and classified with overweight and/or obesity.

Types of interventions

Were analyzed well-defined HIIT and SIT protocols. HIIT is characterized as an exercise protocol carried out by short intermittent periods of vigorous activity, alternated with recovery intervals or low-intensity exercise. The interventions should be at least 4-weeks period, not involving manipulation of supplementation or hypocaloric diet.

Comparisons

Were compare the effect pre to post-intervention effect size, as well the HIIT protocols according to its work/recovery ratio. Comparisons were designed as: HIIT ratio 1:1 vs HIIT ratio 2:1; HIIT ratio 2:1 vs HIIT ratio 1:2; and HIIT ratio 1:2 vs HIIT ratio 1:1.

Outcomes

The primary outcome of this study was the body fat mass (%), and the secondary outcomes were body mass (kg), and waist circumference (cm), measured by the difference in change from the baseline and post intervention.

Search strategy

Searches were performed in till July of 2019, without data limit of publication, in the following electronic databases: MEDLINE (the Medical Literature Analysis and Retrieval System on-line) via PubMed, ScienceDirect, SPORTDiscus, LILACS (Latin American and Caribbean Center on Health Sciences Information) and SciELO. The general search strategy applied in each database involves an advanced search option with a combination of the following MeSH (Medical Subject Headings) and DECs (Health Sciences Descriptors) terms, in Portuguese and English: (Child [All Fields]) OR Adolescent [All Fields]) OR Youth [All Fields]) OR Teens[All Fields]) AND Body composition[All Fields]) OR Body fat[All Fields]) OR Waist circumference [All Fields]) AND High-intensity interval training [All Fields]) OR High-intensity intermittent exercise [All Fields]) OR Sprint interval training [All Fields]). In addition, the reference lists of the included studies were examined for potential studies that could be included in the analysis. There was no temporal-delimitation period.

All the stages of search, selection and election of the studies were assessed independently by two investigators, F.J.M.J. and I.C.J. Still, the divergences were discussed among researchers and solved at consensus meetings. When necessary, a third researcher (N.L.) was consulted.

Data extraction

Two investigators (F.J.M.J. and I.C.J.) abstracted all data independently. For each study, the extracted data consisted of the sample size, characteristics of participants, exercise programmes (i.e., type, protocol ratio, frequency, duration and intensity) and measures of outcome variables, including body fat mass (%), waist circumference (cm) and body mass (kg) with the corresponding differences in the mean from pre-intervention or post-intervention mean values and standard deviations. The protocol ratios were classified as HIIT ratio 1:1 (i.e., the ratio between effort and rest intervals were equal), HIIT ratio 1:2 (i.e., the rest interval was at least two times more than the effort interval) or HIIT ratio 2:1 (i.e., the effort interval was at least two times more than the rest interval). When there was insufficient information on the results or protocols, the corresponding author was contacted.

Quality of studies and risk of bias

The risk of bias was assessed by following the PEDro Scale protocol for randomised-controlled trials (RCT) studies[15]. The scale is composed of eleven relevant criteria for quasi-experimental and experimental studies. The risk of bias was determined as follows: articles that had reached less than six points were considered as a high risk of bias; articles that reached between six and seven points were considered as a moderate risk of bias; and articles that reached above seven points were considered as a low risk of bias.

Statistical analysis

The meta-analysis was conducted via a random effect model of the Review Manager version 5.3 software. The effect size was obtained from the change of the pre and post intervention, in mean and standard deviations. Furthermore, values of the standardised mean difference (SMD) and the standard error (SE) were adjusted and calculated for all HIIT groups[16]. HIIT protocols were divided in subgroups regarding the protocol ratio between effort and rest intervals (HIIT ratio 1:1, HIIT ratio 1:2 and HIIT ratio 2:1), respectively. The overall effect of all protocols and for each protocol ratio were analysed. A significance value of $p<0.05$ and confidence interval (CI) of 95% were considered. In addition, the analysis of heterogeneity among the studies was obtained through an I^2 test, in which I^2 was considered small (<25%), medium (25-50%) and large (>50%) quantities of inconsistency[17]. Data were pooled if outcomes were reported by at least two studies.

Sensitivity analysis was performed following three procedures: (1) reporting studies longer than eight weeks of intervention; (2) removing the classified studies with a high risk of methodological bias; (3) removing studies carried out through cycling exercises. The funnel plot and the Egger test were used to examine publication bias[18].

Meta-regression analyses were performed to determine the relationship between the duration of the bout, total work time, total recovery time and total time of training, with changes observed in the outcome variables.

Results

Study selection

From the 3,491 studies found, 17 were included in the qualitative and quantitative analysis. The search, screening and eligibility steps are described in Figure 1.

Description of studies

The studies were published between 2009 and 2018. The final analysis included a total of 289 youths who participated in the HIIT interventions. The majority of the studies included both boys and girls, three included only girls[19–21] and one study included only boys[22]. Most of the studies included adolescents (from 10 to 18 years) and only two enrolled children and adolescents (from 8 to 12 years old)[23,24]. Eight studies recruited exclusively overweight youth[24–30]. Whereas, eleven studies included obese subjects[19,20,22,23,31–34].

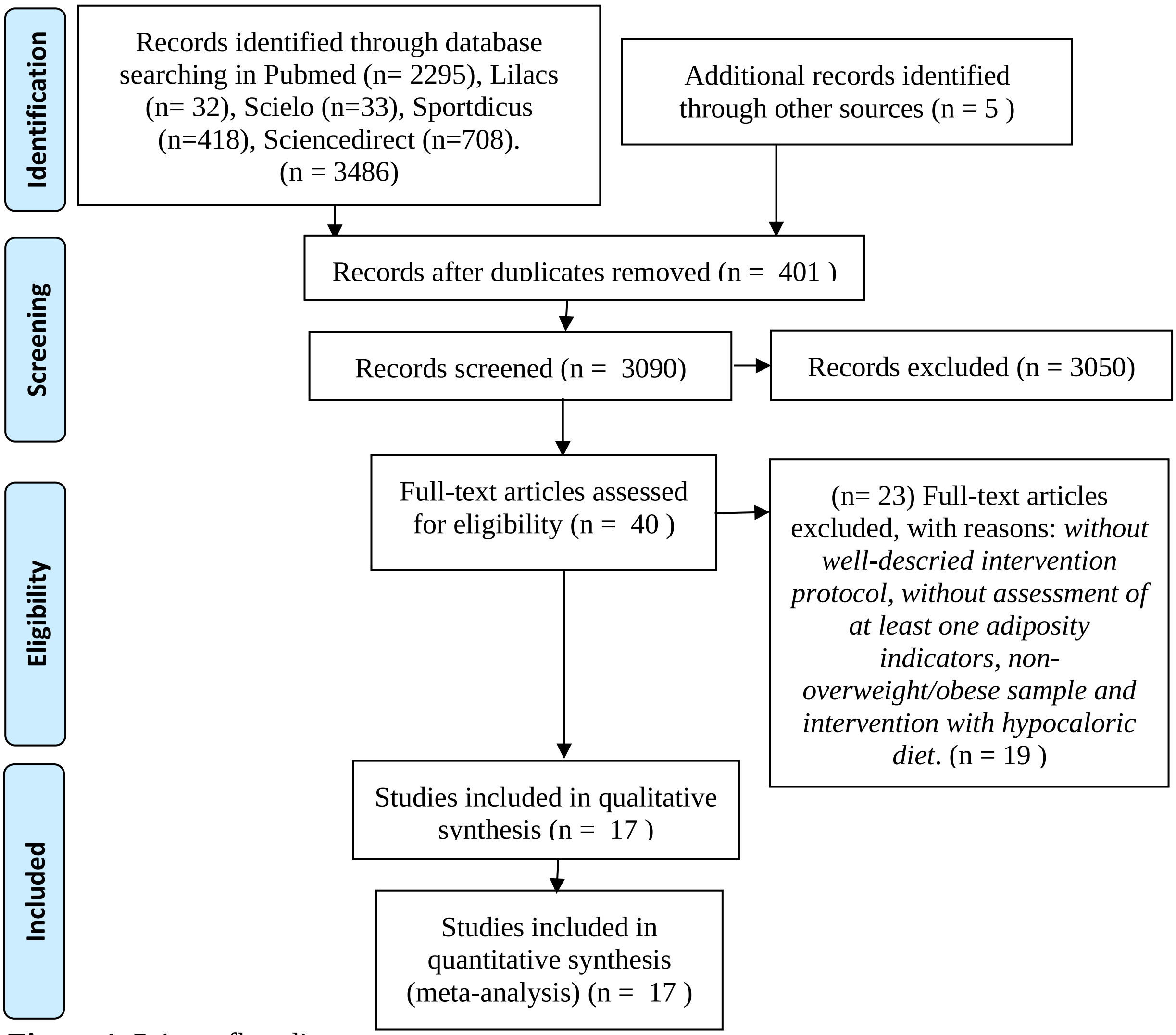

Figure 1. Prisma flux diagram.
Source: The authors

Intervention characteristics

The interventions lasted from 4 to 26 weeks, (mean=11.7±5.9 weeks). In majority of the studies, the HIIT frequency was three times a week, and it was twice a week in two of the studies[24,25,35]. The exercise programmes were performed by running[20–26,29,33] or cycling[28,30–32,34]. The exercise intensity was supervised by either maximum or peak velocity[19,21,23,24,26,29,33], maximum heart rate[25,27,28,31,32,34,35], peak oxygen uptake[20,22] or watts[30]. Among the protocols, five were classified as ratio 1:1[19,20,21,26,29], six were classified as ratio 1:2[23,27,28,32–34] and six were classified as ratio 2:1[22,24,25,30,31,35].

Protocol ratio 1:1 showed a total training time of 11.2 ± 4.9 minutes and a total work time of 6.1 ± 2.2 minutes. In addition, it corresponded between 6-16 bouts, with intervals of work and recovery of 15-60 seconds, at intensities of 100-120% of VO_{2peak}, 100% VO_{2peak} and 95% HRmax. Protocol ratio 1:2 showed a total training time of 24.2 ± 8.4 minutes and a total work time of 8.2 ± 2.9 minutes. In addition, it corresponded between 4-14 bouts, with 15-60 seconds of work and 30-180 seconds of recovery, at intensities of 100% VO_{2peak} and 70-100% of HRmax. Lastly, protocol ratio 2:1 showed a total training time of 23.2 ± 12.7 minutes and a total work time of 14.9 ± 8.9 minutes. In addition, it corresponded between 4-10 bouts, with 20-360 seconds of work and 10-180 seconds of recovery, at intensities of 90-170% watts peak, 80-95% HRmax and 80-95% VO_{2peak}.

Risk of bias

The methodological risk of bias assessment determined that the mean of quality of studies was moderate (mean score=6.5±1.1; range from 4 to 8). Among the studies, two were classified as a low risk of bias[25,28], thirteen were classified as a moderate risk of bias[19–24,30,32,34,35] and three were classified as a high risk of bias[26,27,29]. Common limitations due to potential bias were related to concealed allocation and blinded therapists and subjects. In addition, only four studies blinded a study assessor[24,25,28,34]. However, the authors acknowledge the difficulty of applying this in exercise-intervention studies. Most studies (76.4%) had randomly allocated subjects, but only one concealed allocation (05.8%)[25]. Six studies had a dropout rate higher than 15%. One study reported a loss of participants to follow-up and applied an intention-to-treat[35].

Meta-analysis

A significant decrease was observed in body fat percentage (SMD=-0.72; CI=-1.21 to -0.24; p=0.003; I^2=84%) and waist circumference (SMD=-0.37; CI=-0.54 to -0.20; p<0.0001; I^2=0%) but not in body mass for the overall effect of post intervention.

Also, data showed a significant difference and major relative risk in decrease body fat percentage, in favour of protocol ratio 1:1 (SMD=-1.65; CI =-2.50 to -0.81; p=0.0001; I^2=84%), followed by protocol ratio 2:1 (SMD=-0.42; CI=-0.68 to -0.16; p=0.001; I^2=0%); however, there was no significant effect of protocol ratio 1:2 (SMD=-0.03; CI=-0.51 to 0.44; p=0.89; I^2=0%). Thus, there was a significant difference between the protocol ratios (X^2= 10.80; I^2=81.3%; p=0.005).

Although there was a significant relative risk of decreasing waist circumference, following the overall effect of interventions, no significant differences were observed between the protocol ratios. However, despite a significant relative risk of decrease in body mass, followed by protocol ratio 1:1 (SMD=-0.45; CI=-0.82 to -0.07; p=0.04; I^2=28%), no significant difference was observed between the protocol ratios nor in the overall effect of interventions, respectively. The forest plot analysis is presented in Figures 2A, 2B and 2C.

Table 1. Characteristics of the studies, sample, protocols, and risk of bias.

Author/ Year	Sample	Protocol datail	Intensity	Frequency	Duration	Risk of bias	Work (total) (min)
Tjønna et al., 2009	(n=20) ♀♂ 14.0±0.3	HIIT (2:1) 4x/240s/180s (AR)	90%/70% HR_{max}	2x/week	12 weeks	Low	16 (28)
Corte de Araujo et al., 2012	(n=15) ♀♂ 8-12	SIT (1:2) 6x/60s/180s (AR)	100%/50% V_{peak}	*x/week	12 weeks	Moderate	6 (24)
Koubaa et al., 2013	(n=14) ♂ 13.0±0.8	HIIT (2:1) *x/120s/60s (PR)	80-95% $VO2_{peak}$	3x/week	12 weeks	Moderate	*
Racil et al., 2013	(n=11) ♀ 15.6±0.7	SIT (1:1) (2) 6-8x/30s/30s (AR)	100-110%/50% V_{peak}	3x/week	12 weeks	Moderate	8 (16)
Starkoff et al., 2014	(n=14) ♀♂ 14.7±1.5	HIIT (2:1) 10x/120s/60s (AR)	90-95%/55% HR_{max}	3x/week	6 weeks	Moderate	20 (30)
Lambrick et al., 2015	(n=15) ♀♂ 8-10	SIT (2:1) 5x/360s/120s (PR)	V_{max}	2x/week	6 weeks	Moderate	30 (40)
Lau et al., 2015	(n=15) ♀♂ 10.4±0.9	SIT (1:1) 12x/15s/15s (PR)	120%V_{peak}	3x/week	6 weeks	High	3 (6)
Murphy et al., 2015	(n=10) ♀♂ 12-18	HIIT (1:2) 10x/60s/120s (AR)	90%/60% HR_{max}	3x/week	24 weeks	High	10 (30)
Racil et al., 2016	(n=23) ♀ 16.6±1	SIT (1:1) 8x/30s/30s (AR)	100%/50% VO_{2peak}	3x/week	12 weeks	Moderate	4 (8)
Racil et al., 2016	(n=17) ♀ 14.2±1.2	SIT (1:1) 8-18x/15s/15s (AR)	100%/50% V_{peak}	3x/week	12 weeks	Moderate	4:30 (9)
Alvarez et al., 2017	G1 (n=12) G2 (n=17) ♂ 11.4±1.7	HIIT (1:2) 8-12x/60s/120s (PR)	70-100% HR_{max}	3x/week	6 weeks	Low	12 (36)
Blüher et al., 2017	(n=20) ♀♂ 13-18 y	HIIT (2:1) 8x/20s/10s (PR)	80-95%/50-60% HR_{max}	2x/week	24 weeks	Moderate	2:40 (4)
Lee et al., 2017	(n=12) ♀♂ 14.9±1.4	HIIT (1:2) 10x/60s/90s (AR)	90%/40-50% HR_{max}	3x/week	4 weeks	Moderate	10 (25)
Ouerghi et al., 2017	(n=9) ♀♂ 18.1±0.9	SIT (1:1) (2) 8-10x/30s/30s (AR)	110%/50% V_{peak}	*x/week	8 weeks	High	8-10 (16-20)
Pizzi et al., 2017	(n=20) ♀♂ 10-15	SIT (1:2) 8x/30s/60s (AR)	100%/50% V_{peak}	3x/week	12 weeks	Moderate	4 (12)
Álvarez et al., 2018	(n=29) ♀♂ 11.2±1.6	HIIT (1:2) 8-14x/40s/60s (PR)	70-100% HR_{max}	3x/week	6 weeks	Moderate	5:20-9:20 (13:20–23:20)
Chuensiri et all., 2018	G1(n=16) G2 (n=16)♀♂ 8-18	HIIT G1 (2:1) 8x/120s/60s (PR) SIT G2 (2:1) 8x/20s/10s (PR)	G1 – 90% (watt) G2 – 170% (watt)	3x/week	12 weeks	Moderate	16 (24) 2:40 (4)

Note = Number of participants; ♀ = female; ♂ = male; y = age; HIIT protocols = (ratio: effort:rest) number of bouts/effort duration / rest duration; AR = Active recovery; PR = Passive recovery; V_{peak} = Peak of maximum velocity; VO_{2peak} = peak of oxygen consumption per minute; HR_{max} = Maximum heart rate; * = missing information.
Source: The authors

Publication bias and sensitivity analysis

No significant publication bias was detected for any of the outcomes in either the funnel plot asymmetry or the Egger test. Regarding the sensitive analysis, including only interventions longer than eight weeks, no significant difference was observed in the results for body fat percentage and waist circumference. However, a significant relative risk of decrease in body mass was observed in the overall effect of intervention (SMD = -0.19; IC = -0.37 to -0.01; p = 0.04), in addition to a significant difference between the protocols in favour of protocol ratio 1:1 (X^2=7.73; I^2=74.1%; p=0.002).

Considering only interventions carried out in running exercises, no significant difference was observed in the results for body fat percentage. A significant reduce of the effect of protocol ratio 2:1 was observed in waist circumference (SMD=-0.21; IC=-0.46 to 0.03; p=0.09). Nevertheless, the overall effect of intervention remained significant. Furthermore, a significant decrease in body mass was observed in the overall effect of intervention (SMD=-0.18; IC=-0.36 to -0.01; p=0.04).

When excluding studies with a high risk of bias, there was a significant increase in relative risk only in reducing body fat percentage in the protocol ratio 1:1 (SMD=-2.07; CI=-2.59 to -1.55; p=0.0001; I^2=51%), as well as a significant decrease in heterogeneity (I^2=51%, p=0,13).

Meta-regression

Duration of the bout and total work time did not predict significant changes in body fat percentage. However, total recovery time and total training time were significant and directly associated to changes in body fat percentage (ß=0.093; Tau^2=0.268; p=0.004; and ß=0.048; Tau^2=0.272; p=0.005, respectively). Duration of the bout, total work time, total recovery time and total training time did not significantly predict changes in waist circumference or body weight.

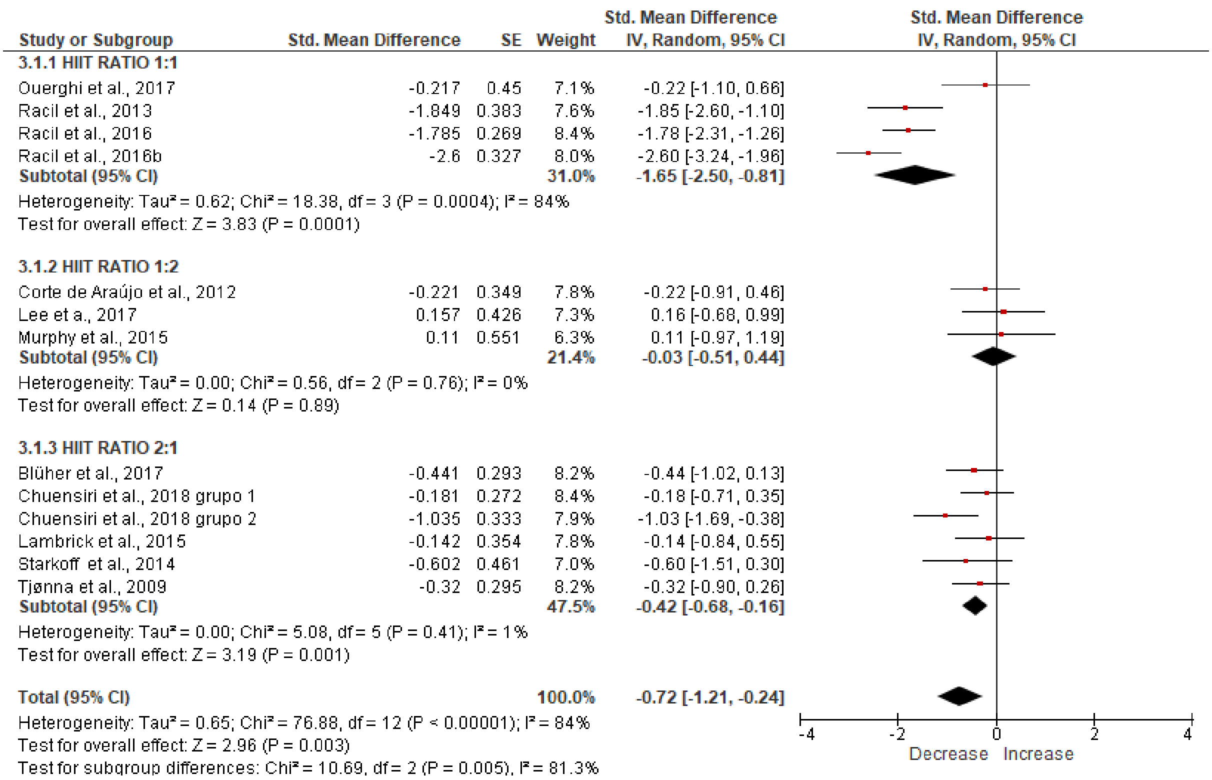

Figure 2A. Comparision between HIIT protocols ratio (effort:rest) on body fat (%)
Source: The authors

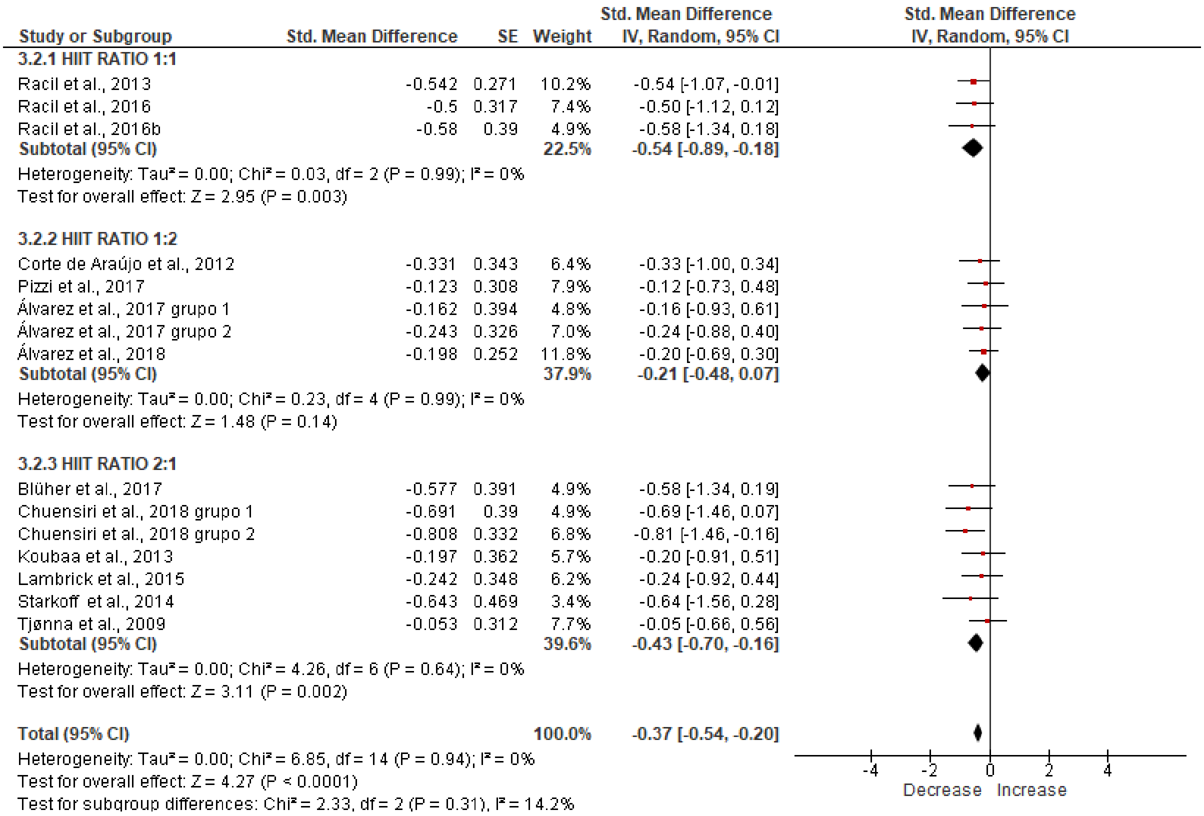

Figure 2B. Comparision between HIIT protocols ratio (effort:rest) on waist circumference (cm)

Source: The authors

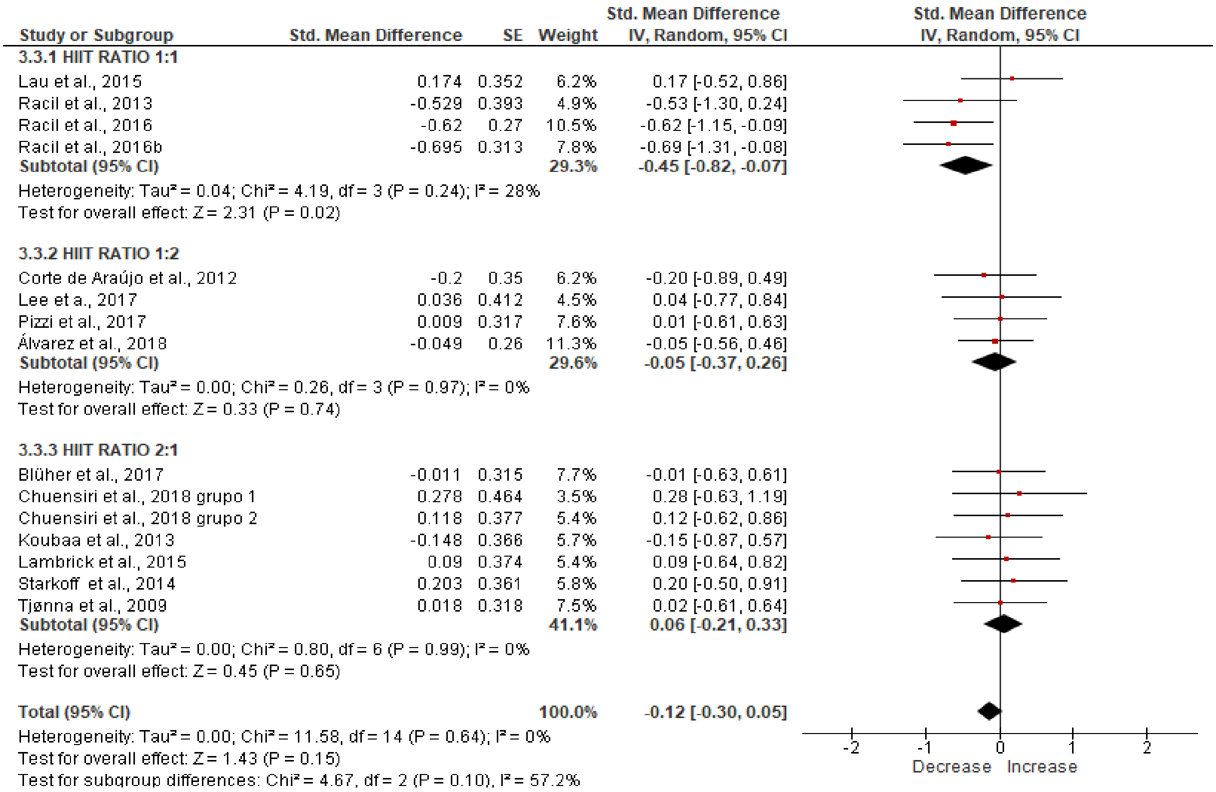

Figure 2C. Comparision between HIIT protocols ratio (effort:rest) on body mass (kg)

Source: The authors

Discussion

The present study is the first meta-analysis to analyse the effectiveness of different work and recovery ratios of HIIT protocols on body adiposity indicators in overweight and obese children. The meta-analysis suggests that an equal ratio between work and recovery in HIIT protocols may promote a major relative risk of decrease in body fat percentage, compared to other HIIT protocol ratios, independently of the total work or training duration.

Previous research has shown that HIIT presented relevant benefits related to cardiometabolic markers, compared to other forms of exercise[4]. According to the study, HIIT interventions produced greater decreases in systolic blood pressure and greater increases in aerobic capacity[4]. Although the relationship between effort time and recovery in HIIT protocols were not analysed, the authors did not find a significant decrease in body fat indicators by following HIIT, compared to other exercise protocols. Furthermore, another meta-analysis also reported that both HIIT and moderate intensity continuous training (MICT) induced similar changes in body fat and waist circumference[36]. However, according to the authors, the duration of HIIT was approximately 40% less than MICT and demonstrated a similar dropout rate[36]. This could indicate that HIIT can stand as a time-efficient and sustainable strategy to induce improvements to body composition in the obese population[5,36].

Recently, a meta-analysis showed that HIIT may be effective in reducing the indicators of adiposity, such as body fat percentage, body mass and waist circumference of overweight and obese children[7]. These results corroborate with our findings, which showed a significant decrease in body fat percentage and waist circumference, on post HIIT intervention. However, we also found that a significant decrease in body weight was only observed when interventions were longer than eight weeks. Previous studies reported that both moderate intensity and high intensity aerobic exercises, even without changes in body weight, can promote significant reduction of body fat and waist circumference[36]. However, apparent changes in body weight seem to appear later compared to any decreases in body fat and waist circumference, following a HIIT intervention.

Several studies aimed to compare HIIT with other types of exercises, but few compared the effectiveness between HIIT protocols. The prescription of HIIT consists of manipulating up to nine variables[8], and the manipulation of any of these variables may affect acute or chronic physiological responses[5,9,10]. In this present meta-analysis, our results suggest that 1:1 protocol ratio can be potentially more effective and promote greater reductions in body fat percentage, as compared to the 1:2 and 2:1 protocol ratio. When approaching all studies with this protocol, it presented high heterogeneity. On the other hand, when applied the sensitive analysis, excluding the studies with high-risk of bias, were observed that one specific study[25] showed high influence in the analysis, and its exclusion significantly reduce the data heterogeneity. Still, due to the lack of studies with this protocol, the results should be interpreted with caution. However, protocol ratio 2:1 showed to be consistent, although slightly less relative risk than protocol ratio 1:1 in reducing the body fat percentage in overweight and obese children and adolescents.

The total training time and the total work time are factors that are largely debated in literature about HIIT, especially when compared to other types of exercise[5,37]. While the protocol ratio 1:1 showed a greater decrease in body fat percentage and body mass, it also showed a greater decrease in total work time and total duration of the intervention, compared to the protocol ratios 1:2 and 2:1 (6.1±2.2 vs 8.2±2.9 vs 14.9±8.9 minutes; and 11.2±4.9 vs 24.2±8.4 vs 23.2±12.7 minutes). Furthermore, the meta-regression model indicated that HIIT protocols with less total training time and recovery were significantly associated with a larger decrease in body fat percentage. This could strengthen the theory of 'time-efficiency' of HIIT protocols.

The benefit of HIIT on fat loss has been proposed to reflect the alterations in metabolism and associated with an increase in hormone-driven rates, such as the catecholamines epinephrine, norepinephrine and growth hormone (GH)[37]. The catecholamine response to HIIT bouts has been described as a significant feature of this type of exercise.[37,38] Secretion of catecholamines has been shown to enhance lipolysis and fat release from subcutaneous and intramuscular fat deposits[38]. In addition, studies reported an acute GH response at only 30 seconds of maximal exercise, which was shown to be ten times greater than baseline levels after 1 hour of recovery[38]. These responses may increase the post-exercise oxygen consumption (EPOC), which may bring long-term benefits to individuals by increasing the basal metabolic rate and caloric expenditure and improving lipid oxidation[5]. Therefore, it is plausible that the benefit of HIIT on fat reduction may occur mostly in the post-exercise period[37].

Limitations and strengths

Our study has some limitations that must be mentioned. Firstly, the lack of studies with HIIT protocol ratios 1:1 and 1:2 may underestimate the efficiency of these protocols; thus, it should be considered. Secondly, the large variety among HIIT protocols, regarding bout duration, total training time, total work time and total recovery time, are factors that may interfere with the analyses.

However, the study also has some strengths, which may contribute to better development of future research on interval training. The data proved that the protocol ratio 1:1 may promote a major relative risk of decrease in body fat percentage, compared to other ratio protocols. However, there are few studies that performed this protocol; thus, it presents a significant variety among the included studies, which makes the final interpretation a cautious challenge. On the other hand, the protocol ratio 2:1 showed to be consistent and effective in reducing body fat percentage.

Conclusion

In conclusion, the similar relationship between work and recovery intervals in HIIT protocols may promote major benefits in body adiposity indicators, compared to other work and recovery ratio protocols and independent of the total work or training duration. However, further studies are needed to better understand the efficacy of the protocol ratio 1:1 in body fat indicators of overweight and obese children and adolescents. On the other hand, the present meta-analysis indicates that the protocol ratio 2:1 evidenced to be consistent and effective in reducing body adiposity indicators in children and adolescents. Therefore, we suggest that future studies should further analyse the HIIT protocol ratios 1:1 and 2:1, aiming to compare different work and recovery durations to better understand the efficiency of such ratios.

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Acknowledgements: This study was financed in part by the Programa Pesquisa Para o SUS (PPSUS) (CP 01/2016) via Fundação Araucária de Apoio ao Desenvolvimento Científico and Tecnológico do Estado do Paraná (Decit/MS), Secretaria da Saúde do Estado do Paraná (SESA-PR), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil CAPES - Finance Code 001, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and by the Fundação para a ciência e tecnologia (FCT: SFRH/BSAB/142983/2018 and UID/DTP/00617/2019).

Author's **ORCID:**
Francisco José de Menezes-Junior: https://orcid.org/0000-0003-4389-1213
Íncare Correa de Jesus: https://orcid.org/0000-0002-1072-9028
Vinícius Lins Ferreira: https://orcid.org/0000-0002-0102-2995
Astrid Wiens: https://orcid.org/0000-0003-4460-4044
Jorge Mota: https://orcid.org/0000-0001-7571-9181
Neiva Leite: https://orcid.org/0000-0002-4752-6697

Received on Mar, 11, 2019.
Reviewed on Nov, 20, 2019.
Accepted on Mar, 30, 2020.

Author address: Francisco José de Menezes-Junior –Rua Coração de Maria, nº 92, Campus Jardim Botânico, Curitiba, Paraná, Brazil - CEP: 80210-132 – E-mail: franciscomenezes@ufpr.